

CLASSIFICATION **CONFIDENTIAL**
 CENTRAL INTELLIGENCE AGENCY
 INFORMATION FROM
 FOREIGN DOCUMENTS OR RADIO BROADCASTS

REPORT

CD NO.

50X1-HUM

COUNTRY USSR
 SUBJECT Economic - Coal
 HOW PUBLISHED Monthly periodical
 WHERE PUBLISHED Moscow
 DATE PUBLISHED Feb 1949
 LANGUAGE Russian

DATE OF INFORMATION 1949

DATE DIST. // Jul 1950

NO. OF PAGES 8

SUPPLEMENT TO REPORT NO.

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF ESPIONAGE ACT 50 U. S. C. 31 AND 32, AS AMENDED. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW. REPRODUCTION OF THIS FORM IS PROHIBITED.

THIS IS UNEVALUATED INFORMATION

SOURCE Ugol', No 2, 1949,

50X1-HUM

ESTIMATING THE METHANE CONTENT OF DEEP DONBASS SHAFTS

G. D. Lidin

/Tables are appended./

It is possible to deduce some empirical principles on the probable rate of methane liberation at deep levels of coal mines on the basis of available factual data.

It is known that the rate of absolute and relative liberation of mine methane increases as mining progresses, with the transition to deeper levels and with increased productivity of the mine. The changes in methane content which occurred from 1898 to 1941 in coal mines in the Donbass are shown in Table 1.

The methane content in mines of the Kuzbass increased even more rapidly; where for an average depth of workings of 100 meters the total liberation of methane amounted to 30,000 cubic meters per day in 1938, it was 70,000 in 1942, and 160,000 in 1946. Judging by preliminary data, the gas content of Karaganda and Georgia mines is high and it must be expected that, as operations increase in these regions, the methane content in mines will equal that now observed in the Donbass and the Kuzbass. The relative methane content in mines varies in different basins, depending on the depth of operations, as shown in Table 2.

From the data in Table 3 it can be established that the gas content of mines increases more or less uniformly with the depth of the mine and that the methane content of mines at the same level is in most cases of the same order in different basins. Slight deviations can be explained by a difference in the gaseousness of the basins and also by a difference in the investigation methods employed.

- 1 -

CLASSIFICATION

CONFIDENTIAL

STATE	<input checked="" type="checkbox"/>	NAVY	<input checked="" type="checkbox"/>	NSRB															
ARMY	<input checked="" type="checkbox"/>	AIR	<input checked="" type="checkbox"/>	FBI															

CONFIDENTIAL

CONFIDENTIAL

50X1-HUM

Information collected on the methane content of Donbass mines from 1937 to 1941 made it possible to establish that the methane content increases comparatively uniformly at the rate of approximately one cubic meter per ton of daily output when the depth of operations has been increased by 26 meters. The same figure for the Kuzbass, judging by the limited data of the upper levels, is approximately 20 meters. It is 40-45 meters for the Ruhr Basin and 20-30 meters for Lancashire.

It follows that the concept of a methane content gradient in mines can be introduced and it can be considered that the methane content in mines, starting at a certain depth (below the zone of gas escape), increases approximately in direct proportion to the depth of mining operations, that is:

$$q \text{ equals } \frac{H - H_0}{a} + q_0$$

where q equals the relative methane content of workings (cubic meters per ton of daily output) at a depth of H meters

q_0 equals relative methane content of workings (cubic meters per tons of daily output) at a depth of H_0 meters

a equals methane content gradient $\frac{\text{meters}}{\text{cubic meters per ton of daily output}}$

During tests made of the formula in a number of Donbass mines it became clear that, using average values of methane content derived on the basis of adequately long observations, results which correspond closely to the given equation are obtained.

Proportional dependency between the methane content and depth of workings is established only after a certain depth, since near the surface coal seams contain either no methane or a very small amount. This zone is called the zone of gas escape; its lower limit is set at the depth at which methane content of the workings reaches 5 cubic meters per ton of daily output, since there is neither persistence nor uniformity in the liberation of methane in mines when the methane content is less.

On the basis of this formula and prolonged observations of gas liberation, the methane content of mines in Tsentral'nyy Rayon and in the Stalino-Makeyevka and Almazno-Mar'yevskiy regions was estimated.

The methane content in mines in Tsentral'nyy Rayon was studied for 5 years. Ample material from these observations permitted deduction of average indexes of methane liberation for a number of levels of the largest mines. Averaged indexes of methane liberation for some mines of the south wall of the anticline are shown in Table 3.

The data cited indicates that the methane content gradient in mines of Tsentral'nyy Rayon ranges from 25 to 36 meters and averages approximately 30 meters.

Using data reported on actual methane liberation at the levels being worked, the depth of the gas escape, and the methane content gradient indicated above, the probable methane content at depths of 1,000 and 1,500 meters has been calculated for some mines of Tsentral'nyy Rayon according to the formula proposed above, and is presented in Table 4. It is evident from this table that the rate of methane liberation reaches 30-35 cubic meters per ton of daily output in the majority of mines at a depth of 1,000 meters and approximately 50-55 cubic meters per ton of daily output for mines at a depth of 1,500 meters.

- 2 -

CONFIDENTIAL

CONFIDENTIAL

CONFIDENTIAL

CONFIDENTIAL

50X1-HUM

These values of probable methane content only apply to average indexes for a mine at various depths. In individual seams the methane content may be two or three times as great as these average figures because of special conditions (presence of adjacent unworked seams and interstratification) and in zones of tectonic disturbances, gas liberation is even greater. It must also be remembered that sudden ejections of gas have occurred in Tsentral'nyy Rayon. All similar extraordinary ejections of gas can occasionally create high concentrations of methane not permitted by operational rules. It must be expected that because of natural and operational conditions it will be necessary on specific occasions in the future to work seams with a methane content on a scale of 200 cubic meters per ton of daily output and containing other sections where the methane content totals 20-30 cubic meters per ton of daily output. All these circumstances demand planned ventilation of the mine, which permits flexibility in the redistribution of air currents.

The gassiest area of Stalino-Makeyevka region is the central part which is bounded on the northwest by a large overthrust. This is the most interesting for estimating the rate of gas liberation in deep mines.

The methane content gradient in this region ranges between 10 and 15 meters for mines of the southwest group (Budennovskiy) and northern group (Shcheglovsko-Chaykinskiy), between 7 and 10 meters for the western group, and between 8 and 12 meters for the Makeyevka group. The depth of the zone of gas escape is 100-200 meters.

Using methods indicated above, the probable methane content at depths of 1,000 and 1,500 meters was determined for certain important mines of these regions and is shown in Table 5. The data cited indicates that the highest gas content can be expected in the area of the "Tsentral'no-Zavodskaya" Mine and Mine imeni Kalinin, i.e., 80-120 cubic meters per ton of daily output at a depth of 1,000 meters and 130-200 cubic meters per ton of daily output at a depth of 1,500 meters. Since, according to our proposition, the gas content is almost, but not quite, directly proportional to the depth, a methane content of not more than 100 cubic meters per ton of daily output at a depth of 1,000 meters and up to 160 cubic meters per ton of daily output at a depth of 1,500 meters should be assumed in planning ventilation.

Mines of the Makeyevka syncline should have a lower gas content. The methane content at depths of 1,000 and 1,500 meters in this area probably amounts to 80 and 140 cubic meters per ton of daily output, respectively. For deep mines of the Budennovskiy and Shcheglovsko-Chaykinskiy group the methane content of workings should not exceed 70 cubic meters per ton of daily output at a depth of 1,000 meters and 110 cubic meters per ton of daily output at a depth of 1,300 meters.

The probable methane contents cited for deep mines of the Stalino-Makeyevka region considerably exceed those for mines of Tsentral'nyy Rayon. This is natural since in the latter area coal seams have a steep dip of 60 degrees and in Stalino-Makeyevka slope at 10-15 degrees. If the influence of the angle of dip is taken into account to calculate the methane content gradient along the slope of the seam instead of vertically, 31-35 meters is the figure obtained for Tsentral'nyy Rayon and 29-38 meters for the Stalino-Makeyevka region, i.e., amounts which differ only slightly.

The majority of mines in the Almazno-Mar'yevskiy region are not deep (up to 200 meters), and methane is liberated either not at all or only in small quantities. Mines in which the depth of operations reaches 300-400 meters have a methane content of from 6 to 11 cubic meters per ton of daily output. Processing of extensive data on gas liberation in the Mines imeni Krupskaya, imeni Menzhinskiy, and "Al'bert" showed that the methane content gradient varies from 20 to 40 meters, depending mainly on the angle of dip of the seams. Methane content for individual mines of the region is shown in Table 6.

- 3 -

CONFIDENTIAL

CONFIDENTIAL

CONFIDENTIAL
CONFIDENTIAL

50X1-HUM

For the Almazno-Mar'yevskiy region it can be assumed that the methane content gradient is 20-25 meters for mines working seams with a dip of 10-20 degrees. The zone of gas escape is 200-250 meters below the surface. In such a case the methane content of deep mines probably reaches 40-50 cubic meters per ton of daily output at a depth of 1,000 meters and 50-70 cubic meters per ton of daily output at a depth of 1,500 meters. Thus, deep mines in the Almazno-Mar'yevskiy region will in all probability have a higher methane content than those in Tsentral'nyy Rayon and a lower content than those in Stalino-Makeyevka.

Estimated methane contents in mines working coal seams at depths of 1,000-1,500 meters are not as unusual as they may seem at first glance and in certain cases the methane content has reached and exceeded these estimates.

In 1937 - 1938 the methane content in some Donbass mines amounted to 70-100 cubic meters per ton of daily output and in individual operational sections was as high as 120 cubic meters per ton of daily output.

Conclusions

1. Under conditions of normal operation the relative methane content of mines, starting at a certain depth (from the lower boundary of the zone of gas escape), increases linearly with the depth of workings. The rate of increase of methane content with the depth (methane content gradient) is determined by natural and operational factors and is different for different basins and regions.

2. From an analysis of the methane content of mines in different regions of the Donbass, it has been established that in the Almazno-Mar'yevskiy region the zone of gas escape reaches a depth of 200-250 meters; in Tsentral'nyy Rayon, 200-300 meters; and in Stalino-Makeyevka, 100-200 meters. The methane content gradients in these areas are 20-30, 25-35, and 7-15 meters, respectively. Using these figures and the proposed formula it is possible to estimate probable methane content at great depths. Calculations showed that the relative methane content of mines in the Almazno-Mar'yevskiy region may reach 40-50 cubic meters per ton of daily output at a depth of 1,000 meters and 50-70 cubic meters per ton of daily output at a depth of 1,500 meters. In Tsentral'nyy Rayon the figures are 30-40 and 40-50 cubic meters per ton of daily output, respectively, and in the Stalino-Makeyevka region 60-100 and 100-140.

3. From the figures cited, it follows that when the mine capacity is 3,000-4,000 tons per day, 20,000 cubic meters of air per minute will be required for the gassiest mines. Such mines will have, in addition to sections with a high methane content (up to 200 cubic meters per ton of daily output), other sections with a relatively low rate of gas liberation (15-20 cubic meters per ton of daily output).

Table 1

	1898 - 1900	1937 - 1941
Daily liberation of methane (cu m per day)	15,000	1,280,000
Liberation of methane (cu m per ton of daily coal output)	0.6	6.4
Average liberation of methane in one gassy mine (cu m per day)	600	8,300
Maximum absolute methane content of mine (cu m per day)	4,300	70,000
Maximum relative methane content of mine (cu m per ton of daily output)	7	100
Number of gassy mines in basin (percent)	21	54
Average depth of mining operations (meters)	Less than 100	220

- 4 -

CONFIDENTIAL
CONFIDENTIAL

CONFIDENTIAL

CONFIDENTIAL

50X1-HUM

Table 2

Level (meters)	Methane Content (cu m per ton of daily output)		Level (meters)	Methane Content (cu m per ton of daily output)	
	<u>Donbass</u>	<u>Kuzbass</u>		<u>Ruhr Basin</u>	<u>Lancashire Basin</u>
0-150	1.2	0.3	0-100	0.4	0.8
150-250	5.7	4.5	100-200	1.2 }	12.0
250-350	9.5	10.0	200-300	5.0 }	
350-450	11.3	--	300-400	6.3	18.4
450-550	16.3	--	400-500	7.0	(31.8)
550-800	20.0	--	500-600	16.7	23.6
--	--	--	600-700	36.7	25.0
--	--	--	700-800	--	32.0
--	--	--	800-900	--	68.3
--	--	--	900-1,000	--	(36.1)
Average	8.8	2.4		6.7	

- 5 -

CONFIDENTIAL

CONFIDENTIAL

Table 3

Mine imeni Dzerzhinskiy		Mine imeni Artem		Mines No 19 - 20 and "Komsomolets"		Mines No 8, No 9, and No 8a imeni Stalin		"Krasnyy Profintern" Mine	
Level (meters)	Cu M per Ton of Daily Output	Level (meters)	Cu M per Ton of Daily Output	Level (meters)	Cu M per Ton of Daily Output	Level (meters)	Cu M per Ton of Daily Output	Level (meters)	Cu M per Ton of Daily Output
40-155	0.1	--	--	--	--	80-170	2.0	--	--
155-225	0.3	--	--	176-257	8.6	--	--	226-440	4.9
225-315	4.2	--	--	--	--	--	--	336-440	7.2
315-435	7.4	315-425	10.8	--	--	340-427	10.0	440-537	11.8
435-516	10.5	425-520	14.3	445-533	16.2	--	--	--	--
516-616	14.0	520-620	17.8	--	--	--	--	--	--

NOTE: The relative methane content for these mines is as follows (in cubic meters per ton of daily output):

Mine imeni Dzerzhinskiy	31
Mine imeni Artem	29
Mines No 19 - 20 and "Komsomolets"	36
Mine "Krasnyy Profintern"	25
Mines No 8, No 9, and No 8a imeni Stalin	32

50X1-HUM

Table 4

Mine	Depth of Level Being Worked (meters)	Actual Liberation of Methane (cu m per ton of daily output)	Gradient of Methane Content meters (cu m per ton of daily output)	Depth of Zone of Gas Escape (meters)	Probable Methane Content (cu m per ton of daily output)	
					At 1,000 Meters	At 1,500 Meters
Mine imeni Artem	520-620	17.8	29	250-300	30-35	40-50
"Komsomolets"	445-533	9.4	30-35	100-150	30-35	40-50
No 1-3 "Kochegarka"	555-640	21.0	25-35	200-350	25-70	35-85
No 8a imeni Stalin	340-427	10.3	30-35	200-250	30-35	40-45
"Krasnyy Profintern"	440-537	13.2	25-30	250-300	30-35	45-55
"Yunyy Kommunar"	265-346	8.5	20-30	200	30-45	55-70

Table 5

Mine	Depth of Level Being Worked (meters)	Actual Release of Methane (cu m per ton of daily output)	Depth of Zone of Gas Escape (meters)	Gradient of Methane Content meters (cu m per ton daily output)	Probable Methane Content (cu m per ton of daily output)	
					At 1,000 Meters	At 1,500 Meters
Stalinskiy Rayon						
"Tsentral'no-Zavodskaya	410	35.0	120-220	7-10	80-120	130-200
No 6 "Kapital'naya	190	7.6	100-200	10-15	60-90	90-140
No 1 - 1 bis	380	20.2	100-200	10-15	60-90	90-140
Makeyevskiy Rayon						
Mine imeni Kaganovich	250	11.1	100-200	8-12	70-100	110-180
"Kapital'naya"	330	19.0				
Mine imeni Lenin	350	23.2				

50X1-HUM

Table 6

<u>Mine</u>	<u>Angles of Dip of Seams (degrees)</u>	<u>Depth of Operations (meters)</u>	<u>Actual Liberation of Methane (cu m per ton of daily output)</u>
No 6 "Golubovka"	5-8	170	1.3
No 3 bis	3-60	180	1.6
"Parizhskaya Kommuna	35	300	5.9
Mine imeni Stalin	40-60	350	6.0
Mine imeni Krupskaya	13-16	400	5.0*

* Average methane content of the Mine imeni Krupskaya amounted to 27 cubic meters per ton of daily output, if methane entering from abandoned workings is taken into account.

CONFIDENTIAL

CONFIDENTIAL

- 8 -
END

CONFIDENTIAL

50X1-HUM